

## A COMPARATIVE STUDY ON THE PHYTOPLANKTON OF THE SHATT AL-ARAB ESTUARY UP AND DOWNSTREAM BASRAH CITY CENTRE, IRAQ

Abdullah H. AL- Mousawi, Hussain A. AL- Saadi & Rafi A. Hadi\*

Department of Biology, College of Science, University of Basrah, Basrah, Iraq.

The phytoplankton are the major primary producers in many aquatic environments especially the estuaries. The Shatt al-Arab estuary is the only source of water supply to the city of Basrah of about one million inhabitants. It receives the untreated sewage of the city by many canals. Several studies have been made on the composition, distribution and ecology of phytoplankton in the Shatt al-Arab (Kell & Saad. 1975; Saad & Kell, 1975; Huq et al. 1978; Al-saadi et al. 1979 and 1981; Schiewer et al 1982; Hameed et al. 1982, Hadi et al. 1984). Few studies were also made on the limnology, primary productivity, phytoplankton composition and pollution status in some of the major sewage- discharging canal of Basrah city (Sarker et al. 1980; Al-Issa 1981; Al- Saadi and Antoine 1981; Antoine and Al-Saadi 1982, Antoine 1983). The effect of sewage input of Basrah city on the phytoplankton of the Shatt al- Arab has received little attention. The present study was planned to show the effect of the sewage input of Basrah city centre on

---

\* Present address: Department of Biology, College of Education for Women, University of Baghdad, Iraq.

phytoplankton composition of the Shatt al- Arab estuary. Enrichment of water samples of the Shatt al- Arab with the major nutrients and its effect on the phytoplankton composition was also included as a preliminary attempts on the assesment of the factors likely to be limiting the growth of phytoplankton in the estuary.

## Materials and Methods

### The study area

The Shatt al- Arab is the most important source of water in the arid surroundings of southern Iraq. Several hundreds canal empty into the Shatt al- Arab from its origin at Garinat Ali upstream of Basrah city to its end in the Arab Gulf. Most of the domestic sewage and industrial effluents are disposed into the estuary by four highly polluted canals namely Al- Rabat, Al-Khandak, AL- Ashar and Al- Khora (Fig. 1). Two stations were selected up and downstream of Basrah city centre. Station I was located about 2Km upstream of city centre and station II was located about 2Km downstream of the city centre. The distance between the two stations is about 5Km. The water level in the Shatt al- Arab is affected by a semi- diurnal tides of the Arab Gulf with an average range of about 1.7m. The mean current velocity is about  $0.8\text{ms}^{-1}$  and the water discharge range between  $300- 2500\text{ ms}^{-1}$  during low flood period (september to December) and between  $2600- 6000\text{ ms}^{-1}$  during high flood period (March to May) (Al- Saadi and Antoine 1981).



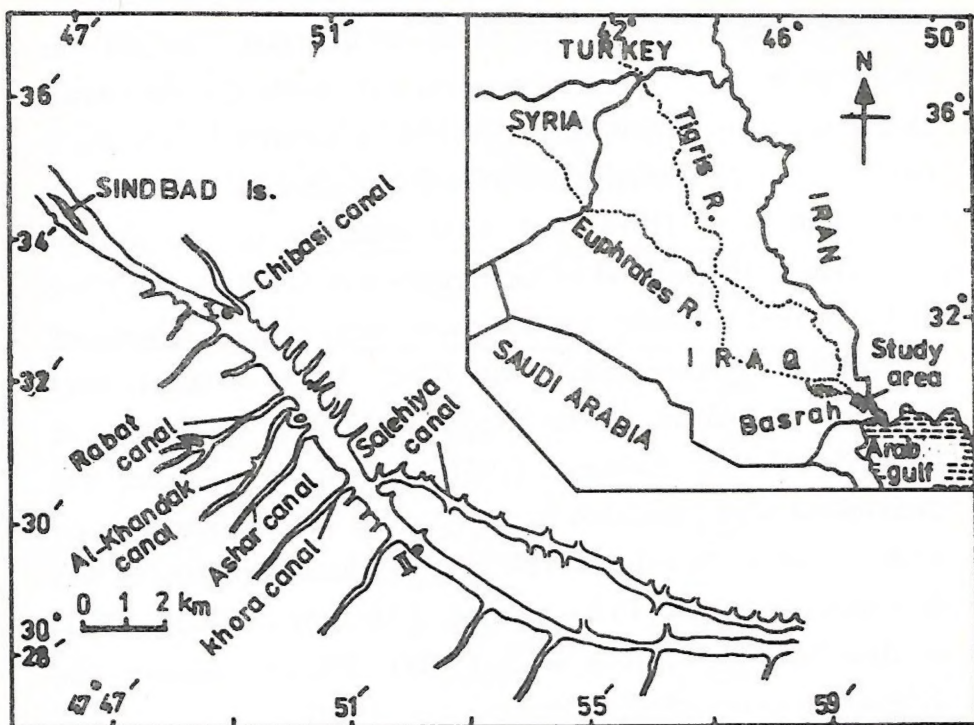


Fig 1, The study area showing the selected stations,  
 I upstream and II downstream Basrah City Centre,  
 Iraq.

Air and water temperatures were measured *in situ* using a thermometer accurate to the nearest 0. 1°C. Light penetration was estimated using a Secchi disc of 30 cm diameter. The pH was measured *in situ* by a digital portable pH- meter (Schatt Gerate model CG817). Dissolved oxygen was measured by the azide modification of the standard Winkler method as described by Mackereth et al. (1978) and total available carbon dioxide according to the method of Golterman et al. (1978) as described by Hadi (1981). Salinity was measured using a digital laboratory salinometer (Tsurumi Seiki model E202). Major nutrients were measured as follows, nitrite- nitrogen following the method of Bendschneider and Robinson (1952) and nitrate- nitrogen was determined after reduction to nitrite using a cadmium column as described by Wood et al. (1967). Phosphate- phosphorus was determined according to the method of Murphy and Riely (1962) as described by Parsons et al. (1984). Silicate- silicon was determined as described by Parsons et al. (1984).

Water Samples used for the study of phytoplankton were collected from both stations. Seven water samples were collected from each station at selected levels of tide (Table 1). Phytoplankton counting and identification were made as described by Hadi (1981). Enrichment of water samples with the major nutrients was made. The nutrients studied were  $\text{PO}_4\text{-P}$ ,  $\text{NO}_3\text{-N}$  and  $\text{SiO}_3\text{-Si}$ ; which were added at a rate of 5, 50 and 200  $\mu\text{mol l}^{-1}$ , respectively. Water samples were taken into Erlenmeyer flasks (ca 3 litres). After enrichment; flasks were placed in an illuminated cabinet (6000 lux) at  $20 \pm 2^\circ \text{C}$ . They were shaken and randomized three times a day. Experiment was terminated five days from inoculation. At the end of the experiment;

**Table 1: Tide level, date and time selected for the collection of water samples from the stations studied.**

tide level	date	time
Low	28- 2- 85	4 pm
high	2- 3-85	8 am
	3-3-85	8 am
Initial low	2- 3- 85	12 noon
	3- 3- 85	12 noon
low	2- 3- 85	4 pm
	3- 3- 85	4pm



phytoplankton counting and identification were made as described previously.

## **Results and discussion**

### **Ecological conditions**

The results of the ecological conditions of the Shatt al-Arab estuary in the two stations studied are shown in Table 2. The results are within the range of the previous studies (Hameed 1977, Al- Saadi et al. 1976; Maulood et al. 1979; Al- Saadi and Antoine, 1982; Antoine 1983; Al- Asadi 1983). Little variation can be seen between the two stations. Several investigators have found that the Shatt al- Arab estuary is a well mixed ecosystem (Mohammed 1965; Hameed 1977). Other investigators have found that sewage input of Basrah city by one or two of the canals is slight and masked by the dilution and tidal effect (Antoine and Shihab 1977; Al- Saadi et al. 1979; Al- Saadi and Antoine 1981; Antoine and Al- Saadi 1982; Saad and Antoine 1983; Al- Asadi 1983).

### **Phytoplankton composition**

A total of sixty- seven taxa were identified in both stations (Table 3). The number of taxa in station I (58) is higher than that of station II (52). The species diversity indices at the stations studied determined by Shannon's formula as described by Wetzel (1983) showed that the species diversity at station I (2.88) is also higher than the species diversity at station II (2.58). Much higher numbers of phytoplankton taxa were recorded in the stations upstream of Basrah city (Saad and Kell 1975; Pankow et al. 1979; Maulood et al. 1981; Al- Saadi et al. 1981; Al- Zubaidy, 1985).

Table 2. Ecological conditions of the Shatt al- Arab estuary at stations studied (Values are mean of seven replicates)

	Station			
	Mean	95% confidence	Mean	95% confidence
Temperature ( $^{\circ}\text{C}$ )				
air	12.23	9.39- 15.07	12.56	10.04- 15.08
Water	12.14	11.89- 12.39	12.24	12.05- 12.43
Secchi disc readings (cm)	79.29	73.67- 84.91	85.14	79.01- 91.27
pH*		7.87- 8.29		8. 10. 8.23
salinity (‰)	1.51	1.48- 1.54	1.51	1.49- 1.53
Dissolved oxygen ( $\text{mg l}^{-1}$ )	9.59	9.43- 9.75	9.55	9.43- 9.67
Percent $\text{O}_2$ saturation (%)	89.31	87.70- 90.92	89.07	87.93- 90.21
Total available $\text{CO}_2$ ( $\text{mg l}^{-1}$ )	220.74	216.27- 225.21	220.73	214.34- 227.12
$\text{NO}_2\text{-N}$ $\text{ugat l}^{-1}$	0.11	0.091- 0.13	0.11	0.082-0.14
$\text{NO}_3\text{-N}$ $\text{ugat l}^{-1}$	6.53	5.96- 7.10	6.67	6.29- 7.05
$\text{PO}_4\text{-P}$ $\text{ugat l}^{-1}$	0.32	0.26- 0.39	0.49	0.34- 0.64
$\text{SiO}_2\text{-Si}$ $\text{ugat l}^{-1}$	92.45	87.17- 97.73	92.26	87.86- 96.66

\* Range of seven replicates, no mean was calculated because the values are log data.

Table 3. Phytoplankton taxa identified in the Shatt al- Arab estuary up and downstream of Basrah City center with their saprobic indices. (a =  $\alpha$ - mesosaprobic, b =  $\beta$ - mesosaprobic, O = oligosaprobic. x = xerosaprobic, + = <100 cell ml<sup>-1</sup> ++ = >100 <500 cell ml<sup>-1</sup>, +++ = >500 <1000 cell ml<sup>-1</sup>, - = not recorded).

Taxa	Station		Saprobic index
	1	11	
<b>Cyanophyta</b>			
<i>Anabaena</i> SP.	+	+	b
<i>Oscillatoria</i> sp	+	+	
<i>Spirulina platensis</i>	+	++	
<b>Chrysophyta</b>			
<b>Bacillariophyceae (Centrales)</b>			
<i>Chaetoceros</i> SP.	+	++	x- b
<i>Coscinodiscus</i> SP.	+	+	
<i>Cyclotella meneghiniana</i>	+	+++	
<i>C. striata</i>	+	+	b- a
<i>Cyclotella</i> SP.	+	++	
<i>Melosira italica</i>	++	+	
<i>Stephanodiscus</i> sp.	+	+	O-b
<i>Thalassiosira fluviatilis</i>	+	+	
<b>Bacillariophyceae (Pennales)</b>			
<i>Achnanthes lanceolata</i> var. <i>rostrata</i>	++	+	x- b
<i>A. minutissima</i>	++	+++	O- b
<i>Amphipleura pellucida</i>	+	++	b
<i>Amphiprora alata</i>	+	+	



<i>Amphora</i> sp.	+	+	x- u
<i>Anomoeoneis exilis</i>		+	x- a
<i>Bacillaria paradoxa</i>	+	++	b
<i>Cocconeis placentula</i> var. <i>euglypta</i>	+	++	b
<i>Cylindrotheca gracilis</i>	+	++	
<i>Cymatopleura solea</i>	+	-	b- a
<i>Cymbella affinis</i>	+	+	o- b
<i>C. microcephala</i>	++	++	
<i>C. turgida</i>	+	+	
<i>Denticula rainierensis</i>	+	-	
<i>Diatoma tenue</i> var. <i>elongatum</i>	++	-	
<i>Diploneis ovalis</i> var. <i>oblongella</i>	-	+	b
<i>Epithemia zebra</i>	+	-	o- b
<i>Fragilaria pinnata</i>	+	-	
<i>Fragilaria</i> sp.	++	++	
<i>Gomphonema gracile</i>	-	+	
<i>Gomphonema</i> sp.	+	-	
<i>Navicula buccella</i>	+	-	
<i>N. cincta</i>	+	-	b- a
<i>N. cuspidata</i>	-	++	b- a
<i>N. inflata</i>	-	+	
<i>N. punctata</i> var. <i>coarctata</i>	+	-	
<i>N. pygmaea</i>	-	++	a
<i>N. radiosa</i>	+	+	o- b
<i>N. radiosa</i> var. <i>tenella</i>	+	-	x- o
<i>N. spicula</i>	+	+	b- a
<i>N. viridula</i> var. <i>rostellata</i>	+	-	
<i>Navicula</i> sp.	++	+++	
<i>Nitzschia acicularis</i>	++	++	a

<i>N. amphibia</i>	++	-	
<i>N. apiculata</i>	+	++	a
<i>N. closterium</i>	+	++	
<i>N. gracilis</i>	-	+	
<i>N. granulata</i>	+	-	
<i>N. hungarica</i>	-	+	a
<i>N. kuetzingiana</i>	++	+	b
<i>N. longissima</i>	+	++	
<i>N. palea</i>	-	+	
<i>N. punctata</i> VAR. <i>coarctata</i>	++	+	
<i>Nitzschia</i> sp.	+++	+++	
<i>Pleurosigma delicatulum</i>	+	+	
<i>Savillea</i> sp.	++	-	b
<i>Synedra acus</i> VAR. <i>radians</i>	+	+	b
<i>S. fasciculata</i>	++	+	
<i>S. ulna</i>	+	+	b
<i>Synedra</i> sp.	++	++	
<b>Chlorophyta</b>			
<i>Chladophora glomerata</i>	+	+++	b
<i>Chlamydomonas</i> sp.	+	+	
<i>Scenedesmus quadricauda</i>	+	+	b
<i>Spirogyra</i> sp.	+	+	o-a
<i>Ulothrix</i> sp.	+	+	o-b

However thirteen taxa were present in station II in number higher than in station I. This may be due to the input of the canals which are characterized by a high number of phytoplankton (Hameed 1977; Al- Saadi and Antoine 1981; Antoine and Al- Saadi 1982; Antoine 1983; Saad and Antoine 1983). The phytoplankton taxa of the two stations were dominated by diatoms. Similar results were found by others (Kell and Saad 1975; Huq et al. 1978; Al- Saadi et al. 1979; Al- Saadi and Antoine 1981). Attempt was made for the distribution and abundance of the taxa in the two stations according to the saprobic index. The indices of Sladeczek (1973) as cited by Hadi (1981) for freshwater algae and of Al- Saadi et al. (1979) were followed. five taxa belong to - mesosaprobic group; 11  $\beta$ -mesosaprobic group; the rest range between xenosaprobic and - mesosaprobic groups. Hameed (1977) reported 26 taxa of the phytoplankton in the Shatt al- Arab estuary as a  $\beta$ - mesosaprobic indicators. In the present study 4 out of 5 taxa of - mesosaprobic group are present in station II in a number higher than their number in station I. Application of F- test as described by Elliot (1977) showed that the differences are highly significant ( $F = 9.39$  at 0.01 level of probability). As was mentioned earlier this may be due to the effect of the sewage- input of Basrah city.

#### **Enrichment study**

Addition of selected nutrients to samples of water from any ecosystem and following the response of its phytoplankton community is one of the several approaches for the assessment of the growth- limiting nutrient (Goldman 1961; Healey 1973 and 1978). Unfortunately, no previous attempt was made for the assessment of the growth- limiting nutrients in the Shatt al- Arab



or any other Iraqi ecosystems. Almost all of the previous studies on the Shatt al- Arab were based on the water chemistry for the assessments of its trophic conditions (Antoine and Shihab 1977; Maulood et al. 1979; Al- Saadi and Antoine 1981; Al- Issa 1981; Antoine and Al- Saadi 1982; Antoine 1983). The data are highly variable (Talling 1980; Al-Asadi 1983). However, Hameed (1977) and Al- Saadi et al. (1979) have used the saprobic indices as indicators of the trophic condition of the Shatt al- Arab. They came to conclusion that the presence of phytoplankton taxa of high saprobic index in the Shatt al- Arab complicated its trophic condition. They have attributed the presence of these taxa to the effect of sewage- discharging canals of Basrah city. In the present study an attempt was made for the determination of the nutrients likely to be limiting for the growth of phytoplankton in the Shatt al- Arab. The results showed that several taxa responded positively for the nutrients added (Table 4). However, the response was obvious for some taxa (e.g. *Cyclotella* spp.) in samples enriched with a combination of nitrogen and phosphorus. On the other hand, most of the taxa of the station I responded more than those of station II. This may indicate that nitrogen and phosphorus are likely to be the nutrients limiting the growth of phytoplankton in the Shatt al- Arab. It may also indicate that the phytoplankton in the Shatt al- Arab estuary upstream Basrah city suffer more than those of downstream. Further studies are required to clarify this point.

Table 4. Effect of addition of major nutrients on phytoplankton taxa of the Statt al-Arab up and downstream Basrah City  
Centre. (+ = <100 cell ml<sup>-1</sup>, ++ = >100 <500 cell ml<sup>-1</sup>; +++ = \500 <1000 cell ml<sup>-1</sup>; ++++ = >1000 cell ml<sup>-1</sup>).

Taxa	Inoculum		Control		Treatment									
					+N		+P		+N+P		+SI			
	Station I	II	Station I	II	Station I	II	Station I	II	Station I	II	Station I	II	Station I	II
<b>Cyanophyta</b>														
<i>Oscillatoria</i> sp.	+	+	+	+	++	++	+	+	++	+++	+	++	+	++
<i>Spirulina platensis</i>	+	++	+	++	+	+++	+	+	++	+++	+	++	+	++
<b>Chrysophyta</b>														
<b>Bacillariophyceae (centrales)</b>														
<i>Chaetoceros</i> sp.	+	++	+	++	+	++	++	+	+	+	+	++	+	++
<i>Cyclotella meneghiniana</i>	+	+++	+++	+++	++++	++++	++++	++++	+	+	+	+	+	+
Kuetz.					+	++	+++	+	++++	++++	++++	++++	++++	++++
<i>C. striata</i>	+	+	+	+	+	++	+++	+	++++	++++	++++	++++	++++	++++
<i>Cyclotella</i> sp.	++	+++	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
<b>Bacillariophyceae (Pennales)</b>														
<i>Achnanthes minutissima</i>	++	+	++	++	+	+	+	+	+	+	+	+	++	+
<i>Denticula rainierensis</i> Sov.	+	+	+	+	+	++	+++	++	+	+	+	+	+++	++
<i>Diatoma tenue</i> var. <i>elongatum</i>	+	+	+++	+	+	+++	+	+++	+	+	+	+	+	++
<i>Fragilaria</i> sp.	++	+	++	+	+	+++	+	+++	+	+++	++++	+++	++++	+++
<i>Navicula acicularis</i> W. Sm.	+	+	+++	+	+	++	+++	+	+++	+	+	+	+	+
<i>N. apiculata</i>	+	+	+	+	+	++	+	++	+	+	+	+	+	+
<i>N. hungarica</i>	+	+	+	++	+	+	+	++	+	+	+	+	+	+
<i>N. kuetzingiana</i> Hisle	+	+	+	++	+	+	+++	+	+++	+	+	+	+	+
<i>N. longissima</i> (Breb) Ralfs	+	+	+	+	+	++	+++	+	+++	+	+	+	+	++
<i>N. palea</i>	+	+	+	+	+	+	++	+	+	+	+	+++	+	+
<i>N. punctata</i> var. <i>coarctata</i>	+	+	+	++	+	+	+	+	+	+	+	+	+	+
<b>Grün</b>														
<i>Navicula</i> sp.	+	+	+	+	+	+	++	+	++	+	+	+++	+++	+
<i>Nitzschia</i> sp.	++	+++	++++	+++	++	++	+++	+	+	+	+	+++	+++	+
<i>Synedra acus</i> var. <i>radians</i>	+	+	+++	+	+	++	++	+	+	+	+	+	+	+
<i>S. fasciculata</i>	+	+	+	+	+	++	+++	+	+	+	+	+	+	+
<i>S. ulna</i> (Nitz.) Ehr.	+	+	++	+	+	+	+	+	+	+	+	+	+	+
<i>Synedra</i> sp.	+	+	+++	+++	+	+	+	+	+	+	+	+	+	+
<b>Chlorophyta</b>														
<i>Cladophora glomerata</i>	+	++	+	++	+	+++	+	+++	+	+++	+	+++	+	+
<i>Scenedesmus quadricauda</i>	+	+	+	+	+	++	+	+	+	+	+	+	+	+

### Acknowledgements

The authors wish to thank Mrs. A. A. Al- Saboonchi in the Marine Science Centre and Mr. A. M. Al- Zubaidi in the Department of Biology, University of Basrah for the help in identifying some species, and to Mr. A. Karieb in the Iraqi Port Foundation for the support and providing the boat for water collection. This work was supported by college of Science, University of Basrah.

### References

- Al- Asadi, M. K. 1983. The regime of some nurients in Shatt al- Arab river and number of its branches at the city of Basrah. M. Sc. Thesis, Department of Biology, College of Science, University of Basrah, Iraq.
- Al- Issa, S. A. (1981). Limological studies on the Shatt al- Arab river and Al- Khandak creek. M. Sc. Thesis, Department of Biology, College of Science, University of Basrah, Iraq.
- Al- Saadi, H. A. and Antoine S. E. 1981. Primary productivity and phytoplankton population dynamics in polluted Ashar canal and Shatt al- Arab, Basrah (Iraq). *Verh. Internat. Verein. Limnol.* 21: 880- 885.
- Al- Saadi, H. A., Pankow, H. and Huq, M. F. 1979. Algological investigation in the polluted Ashar canal and shatt al- Arab in Basrah (Iraq). *Int. Revue ges. Hydrobiol.* 64: 527- 540.
- Al- Saadi, H. A., Antoine, S. E. and Islam, N. A. K. M. 1981. Limnological investigation in Al- Hammara marsh area in southern Iraq. *Nova Hedwigia.* 35: 157- 166.



- Al- Zubaidi, A. M. 1985. Ecological study on the algae (phytoplankton) in some marshes near Qurna- southern Iraq. M. Sc. Thesis. Department of Biology, College of Science, University of Basrah, Iraq.
- Antoine, S. E. 1983. Limnological investigation in the polluted Rabat canal and the Shatt al- Arab River, Basrah, Iraq. *Nova Hedwigia*. 38: 497- 518.
- Antoine, S. E. and Shihab, A. F. 1977. On the distribution of inorganic nitrogen and phosphate in polluted Al- Khora River and Shatt al- Arab at Basrah, Iraq. *J. Asiatic Soc. Bangladesh (Sc)* 2: 35- 41.
- Antoine, S. E. and Al- Saadi, H. A. 1982. Limnological studies on the polluted Ashar canal and Shatt al- Arab River at Basrah (Iraq). *Int. Revue ges. Hydrobiol.* 67: 405-418.
- Bendschneider, K. and Robinson R. J. 1952. A new spectrophotometric determination of nitrite in sea water. *J. mar. Res.* 11: 87-96.
- Elliott, J. M. 1977. Some methods for the statistical analysis of samples of benthic invertebrates. 2nd ed. Freshwater Biological Association Sc. Pub. No. 25.
- Hadi, R. A. M. 1981. Algal studies on the River USK. Ph. D. Thesis. University College, Cardiff. U.K.
- Hadi, R. A. M., AL- Saboonchi, A. A. and Haroon Y. A. K. 1984. Diatoms of the Shatt al- Arab River, Iraq. *Nova Hedwigia*. 39: 513- 557.
- Hamoud, A. H. 1977. Studies on the ecology of phytoplankton of Shatt al- Arab River at Basrah, Iraq. M. Sc. Thesis, University of Basrah.

- Hameed, H. A., Al- Saadi, H. A. and Huq, M. F. 1980. The diurnal variation of the total number of phytoplankton, amount of chlorophyll-a and some selected physico-chemical parameters of the Shatt al- Arab River at Basrah, Iraq. *Limnologica* 14: 27-33.
- Huq, M. F., Al- Saadi, H. A. and Hameed, A. H. 1978. Phytoplankton ecology of Shatt al- Arab River at Basrah, Iraq. *Verh. Internat. Verein. Limnol.* 20: 1552- 1556.
- Goldman, C. R. 1961. Primary productivity and Limiting factors in Brookes lake, Alaska,. *Verh. Internat. Verein. Limnol.* 14: 120- 124.
- Golterman, H. L., Clymo, R.S. and Ohnstad, M. A. M. 1978. Methods for physical and chemical analysis of fresh waters. IBP Handbook No.6. 2nd ed. Blackwell Scientific Publications.
- Healey F.P. 1973. Inorganic nutrient uptake and deficiency in alge. *CRC Crit. Rev. Microbiol.* 3: 69- 113.
- Healey F. P. 1978. Physiological indicators of nutrient deficiency in algae. *Met. Internat. Verein. Limnol.* 21: 34-41
- Kell V. and Saad M. A. H. 1975. Investigation on the phytoplankton and some environmental parameters of Shatt al- Arab (Iraq). *Int. Rev. ges. Hydrobiol.* 60:409-421
- Mackereth, F. J. H., Heron, J. and Talling, J. F. 1978. Water Analysis: Some revised methods for Limnologists. FBA. Sc. Publ. No. 36.
- Maulood, B. K. Hinton, G. C. F., Kamees, H. S., Saleh, F. A. K., Shaban, A. A. and Al- Shahwani, S. M. H. 1979. An

- ecological survey of some aquatic ecosystems in Southern Iraq. *Tropical Ecology*. 20: 27-40.
- Maulood, B. K., Hinton, G. C. F., Whitton, B. A. and Al-Saadi, H. A. 1981. On the algal ecology of the lowland Iraqi marshes. *Hydrobiol.* 80: 269- 276.
- Mohammad, M. B. M. 1965. Preliminary observations on some chemico- physical features of the Shatt al- Arab estuary. *Proc. Iraq Sci. Soc.* 6: 34- 40.
- Murphy, J. and Riley, J. P. 1962. A modified single solution method for the determination of phosphate in natural waters. *Anal. Chim. Acta.* 27: 31- 36.
- Pankow, H., Al- Saadi, H. A., Huq, M. F. and Hadi, R. A. M. 1979. On the algal flora at the marshes near Qurna (Southern Iraq). *Willdenowia* 8: 493- 506.
- Parson, T. R., Maita, Y. and Lalli, C. M. 1984. A manual of chemical and biological methods for seawater analysis. Pergamon Press. Oxford.
- Saad, M. A. H. and Antoine, S. E. 1982. Effect of pollution on phytoplankton in Al- Khandak and Al- Rabat, polluted outlet canals of the Shatt al- Arab estuary at Basrah, Iraq. *Int. Rev. ges. Hydrobiol.* 67: 419- 429.
- Saad, M. A. H. and Kell, V. 1975. Observations on some environmental conditions as well as phytoplankton blooms in the lower reaches of Tigris and Euphrates. *Wiss. Z. Univ. Rostock, Reihe Math* 24: 781-787.
- Sarker, A. L., Al- Nasiri, S. K. and Hussein, S.A. 1980. Diurnal fluctuations in the physico- chemical conditions of the Shatt al- Ara and the Ashar Canal. *Proc. Indian Acad. Sci. (Anim. Sci.)* 89: 171-181.



- Schiewer, U., Al- Saadi, H. A. and Hameed, H. A. 1982. On the diel rhythm of phytoplankton productivity in Shatt al- Arab ot Basrah, Iraq. Arch. Hydrobiol. 93: 158- 172.
- Talling, J. F. 1980.6. Water characteristics. In: Rzoska J. Euphrates and Tigris, Mesopotamian Ecology and Destiny. pp. 63- 79. W. Junk. The Hague, Boston and London.
- Sladeczek, V. 1973. System of water quality from the biological point of view. Arch. Hydrobiol. Ergebn. Limnol. 7: 1- 218.
- Wetzel, R. C. 1983. Limnology. 2nd ed. Saunders College Publications. Philadelphia, U. S. A.
- Wood, E. D., Armstrong F. A. J. and Richards F. A. 1967. Determination of nitrate in sea water by cadmium- copper reduction to nitrite. J. mar. Biol. Ass. U. K. 47: 23-31.

### **Summary**

Two stations were selected in the Shatt al- Arab estuary, up and downstream Basrah city centre. Seven water samples were collected from each station at selected tide levels. The number of phytoplankton taxa in the Shatt al- Arab was higher in the station upstream Basrah city centre compared with downstream station. The number of - mesosaprobic taxa showed a reverse pattern of distribution. The enrichment of water samples with the major nutrients indicates that the phytoplankton of the Shatt al- Arab is likely to suffer from the deficiency of nitrogen and phosphorus in upstream station more than the downstream one.

## « الملخص »

تمت دراسة مقارنة للهائمات النباتية في محطتين في مصب شط العرب اعلى واسفل مركز مدينة البصرة. جمعت سبع عينات من الماء من كل محطة في مستويات مختارة من المد. وجد ان عدد الهائمات النباتية في المحطة العليا اكثر من عددها في المحطة اسفل وكذلك الحال بالنسبة الى تنوع الانواع في حين اظهر عدد الهائمات من مجموعة mesosaprobic - نتيجة معاكسة في التوزيع. وظهر من اغناء عينات الماء بالمغذيات الرئيسة ان الهائمات النباتية في شط العرب قد تعاني من نقص في التروجين والفسفور في المحطة العليا اكثر منه في المحطة السفلى.